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THE FOOD OF COLLEMBOLA

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The statement that insects feed on organic matter in general should be placed, I think, under the second clause of that neat French aphorism: "No generalization is always true, not even this one". For it is doubtful if any form of matter ever elaborated by living protoplasm is not food for some insect or another. Ranging between the extremes of a famishing diet like the driest of long-dead cellulose and the rich nourishment of warm human blood, the inordinate insect bill-of-fare comprises an inconceivable variety of substances, including such unlikely victuals as poison ivy, cayenne pepper, wormwood, deadly aconite, belladonna, cantharides and strychnine, to mention only a few. Apparently it is only their lack of chlorophyl and consequent inability to assimilate mineral matter that keeps them from eating holes in the universe. The vast variety of insect foods is, of course, due to the vast variety of insects. Greatly out-numbering all other forms of animal life, insects find the world thronged with their fellows and all the ways of living crowded. In their efforts to discover an unpreempted provender, they have made innumerable experiments in foods, and so have gradually evolved a practically limitless menu.

Naturally, such a universal appetite can be attributed only to the great Class Insecta as a whole. A small Order of minute insects like the Collembola, including no great difference in morphology and with relatively weak mouth parts, must necessarily be content with a more restricted diet. Yet even among them there is a considerable variety of foods.

No other anatomical character tells so much about an animal's habits as its mouth parts. The Collembola are one of the few insect orders that are both mandibulate and suctorial. While the majority have jaws fitted for biting and chewing, in some genera the mouth parts are stiliform and produced into a sharp cone adapted for penetrating tissues and sucking up liquids. But unlike many of those arch-suckers, the bugs, the suctorial Collembola, so far as known, are never guilty of feeding on the blood of other creatures nor on the juices of man's treasured crops. Such an honourable acquittal cannot be given to all the mandibulate Collembola, a few of whom attain the doubtful distinction of "economic insects", but the suctorial species seem to find an innocent nourishment in the fluids of rotting wood and fungi.

The jaws of the mandibulate Collembola are armed at the apex with several sharp cutting teeth, usually five teeth in the right jaw and four in the left jaw, the uneven numbers permitting the teeth to mesh into one another with the ends of the jaws flush. A little behind the apical teeth most species have a many-ridged molar plate for comminuting their food, but a few are without any such grinding apparatus. The distinction denotes in general a difference in diet, the molar surface indicating (with only one known exception) a vegetable diet, while the absence of a grinding plate points to a carnivorous habit.

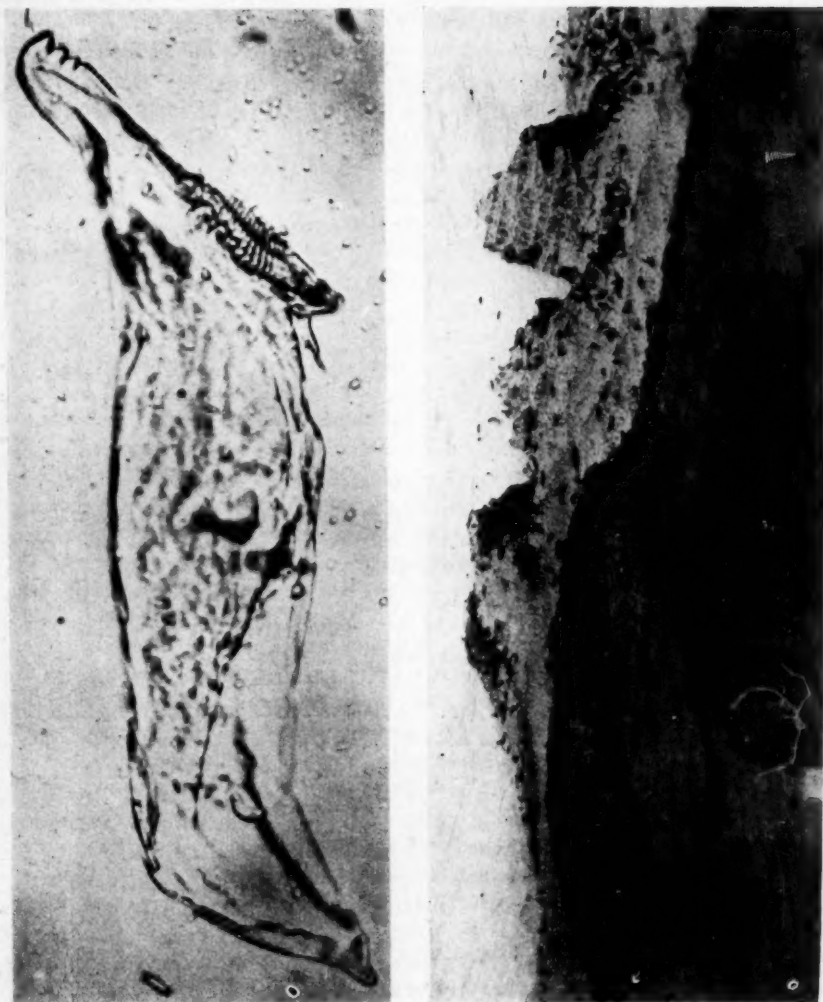
Primarily all animals must have fed on vegetable matter; flesh eating as a short-cut to nutrition was a secondary discovery. It seems appropriate, then, that primitive insects like the Collembola should be mostly vegetarians. Food is always related to habitat, and living chiefly under loose bark and dead leaves, or in moss, rotten wood, or moist earth, Springtails feed largely on the vegetable substances, tender from decay, which surround them, or on the moulds and minute algae which flourish in such situations. Fungi are a favorite food of many species and both spores and pieces of mycelium are often to be found in their stomachs. The molar plates on the mandibles with their numerous trans-



Fig. 1.—Fungi spores in food mass of *Achorutes socialis* Uzel. Greatly magnified.

verse folds bear a curious resemblance, microscopic as they are, to the enormous, ridged teeth of the mighty mammoth, and look like very efficient grinders. Nevertheless, the insects do not always use them, and ignoring the precepts of the excellent Mr. Fletcher, they swallow much of their food without chewing it. While most of the food seen in their stomach is an indistinguishable pulp, there are often fair sized particles of wood and uncrushed fragments of mycelium in it; and fungus spores, with which the gut is sometimes packed, seem to be invariably swallowed whole. Liquid food also attracts these chewers, and in the spring several species, particularly of the genus *Achorutes*, may be seen in large numbers feeding on the sweet sap exuding from freshly-cut maple stumps. Sometimes they cause considerable annoyance to maple sugar makers by getting into the sap pails.

Species that live on the surface of pools and streams, such as *Isotoma palustris* Mull, and *Sminthuris aquaticus* Bourl., often pick up diatoms and



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- 1 Jaw of *Isotoma* sp. showing apical incisive teeth and molar plate. Greatly magnified.
- 2 Vertical view of freshly cut maple stump with *Achorutes socialis* Uzel feeding on sap. Natural size.

desmids, and in the spring feed largely on the pollen which the conifers lavish on the wind. According to the Swiss writer, Handshin, coniferous pollen is also the manna that falls from heaven for the Collembola inhabiting the snow and ice deserts of the Alpine glaciers. Our winter species, when they come out on the snow, usually make their excursions on what the Irish call "a bare-fut stomach", and seldom have food of any kind in them.

Other pollen-eating species go direct to the flowers of various plants. In Switzerland, Handshin says, *Sminthurus hortensis* Fitch is always found in the blossoms of *Ranunculus glacialis*, and in this country the same species is common on dandelion blossoms.

Unfortunately, *S. hortensis* does not always confine itself harmlessly to wild flower pollen. The Collembola are not classed as an order of any great economic importance, but some of them do occasionally attack cultivated crops in the seedling stage, and in 1910 Theobald recorded 23 injurious species in Europe. In America *Achorutes armatus* Nic. sometimes makes a nuisance of itself in beds of cultivated mushrooms, and a few other species have some bad marks against them. But *Sminthurus hortensis* is the chief culprit. The list of plants it is known to injure reads like the index to a seedsman's catalogue: beans, beets, cabbage, cantaloupes, carrots, clover, corn, cucumber, kale, lettuce, mangolds, onions, peas, potatoes, radishes, rye, spinach, squash, tobacco, tomatoes, turnips, violets, watermelons, wheat, wild cucumber. Its depredations make it the most widely known of Springtails. And just as the Japanese, for all their exquisite art and literature, won no standing among the nations until they killed a large number of Russians, so the Collembola are gaining respect among entomologists, not from the blameless and retiring life led by the great majority of the order, but because *Sminthurus hortensis* now and then eats up whole fields of onions.

As an offset to these spoliations, it is a pleasure to be able to credit the Collembola with at least one beneficial act. Collinge states that on a sewage farm in England filtration has to be stopped from time to time to get rid of a colloidal deposit that collects in the filters. But sometimes *Achorutes viaticus* appears in millions and destroys the deposit (presumably by eating it) and there is then no necessity for stopping the process of filtration.

The species definitely known to be carnivorous are few, and further study of Collembolan life-histories will probably reveal others. In some cases the ingestion of animal food is only occasional. *Tomocerus flavescens* Tullb., Folsom says, swallows its cast skin immediately after moulting. This *Tomocerus*, which is common under dead leaves, has large molar surfaces on its jaws and its regular food is decaying vegetable matter. The cast skin it eats now and again seems to be in the nature of a hors d'oeuvre. Lie-Pettersen saw two female *Sminthurus novemlineatus* Tullb. feeding on a dead male (incidentally proving that the vamp has a long ancestry) and while I can find no other mention of the food habits of this species, I am inclined to think, from its close resemblance in structure, including a molar plate, and similarity of habitat to the vegetarian *S. aquaticus* Bourl., that it is normally a vegetarian also. I once found an *Entomobrya hexfasciata* Harvey with its mid-gut packed full of nematode larvae, but these worms are so often parasitic that it is very probable the springtail was food for them,

and not that they were food for the springtail. In passing it may be remarked that those lowly and seemingly harmless endoparasites, the gregarines, are frequent in Collembola stomachs. The Antarctic species, *Isotoma brucei* Carp., found by the "Scotia" expedition—"innumerable specimens on the sea-shore on the carcass of a penguin"—is possibly a carnivore, but the record does not say if it was actually eating the bird's flesh, or if, as seems likely from its well-developed molar plate, it was feeding on some algal or other growth on the dead body.

But an undoubted flesh-feeder is *Anurida maritima* Guérin, an inhabitant of the sea-shore, whose mandibles, provided with sharp, irregular teeth well adapted for cutting, are without a molar surface. Sixty years ago Laboulbène noticed that it fed on dead molluscs, an observation confirmed by Folsom, who says the insect's principal food is the soft tissues of the mollusc *Littorina littorea*, as well as dead fish cast up on the shore. Imms slightly extended the diet to include an occasional desmid or other green alga.

Motter's courageous study of the fauna of the grave brought to light another carnivorous springtail in *Isotoma sepulcralis* Fols., which was abundant with a large percentage of the 150 corpses examined. Dr. J. W. Folsom, who described the species and examined thousands of cotypes, tells me that the stomachs of these ghoulish Collembolans were filled with decayed human flesh. This species differs from other carnivorous springtails in having molar plates on its jaws.

Anurida maritima and *Isotoma sepulcralis* feed on dead fish only. Two other carnivorous species, *Friesca sublimis* Macn. and *Isotoma macnamarai* Fols., whose habits are to be here described, are raptorial and devour living prey, this being the first record, as far as I can ascertain, of such a practice among the Collembola.

Friesca sublimis lives under the loose bark of maple trees. It is a rather inactive, stout-bodied insect only about one mm. long, and its reduced leaping apparatus is all but functionless. The sharp, uneven teeth on its molarless jaws resemble those of *Anurida maritima* and are evidently intended for cutting, but the jaws themselves are small and weak, a deficiency perhaps compensated for by the exceptionally strong and heavy maxillae with their simple, sharp-pointed heads. A dozen individuals collected the first of November were put in a vial with some fragments of moist, decaying wood, and were observed every day all winter, but it was hard to see what they were doing, as they usually kept themselves hidden in crevices in the wood. Most of them died during the winter, and by March only four were alive. While examining them about 9 p.m. on the second of March I saw one of them eating a live companion. The feeder was holding the victim firmly in his jaws, the body being raised clear of any support, and he was chewing away steadily. He never changed his position in the slightest, the only movement being that of his jaws. He had begun at the posterior end, and when first observed about half the abdomen was reduced to a pulp and the victim's legs were moving only feebly. Occasionally the feeder ceased chewing and remained perfectly still for thirty minutes or an hour, but continued to hold the prey in his jaws. He began eating again whenever I disturbed him by shaking the vial. He seems to have continued this procedure all night, and next morning was still chewing and resting by turns. The process was very slow, and by noon there still remained a

third of the thorax and the head. At 5 p.m. he had disappeared into some cranny in the wood, leaving the remains behind him, now reduced to a small, shapeless mass. The body had evidently been thoroughly masticated to extract the juices, but none of the chitinous material had been swallowed. I observed no more feeding and about ten days later all the insects were dead.

While not at all abundant, *F. sublimis* generally occurs in small colonies of ten to twenty individuals, and as cannibalism is not consistent with a gregarious habit, it is probable that in the case observed, hunger had driven the insects to eat one another. Their normal prey is likely some of the numerous minute creatures that occupy the same habitat of moist, decaying wood.

Isotoma macnamarai, our second raptorial species, is about 2 mm. long with a remarkably big square head. The younger individuals are olive-green in color, and the more mature are a fine steel-blue. The insect's stout mandibles have the usual incisive teeth, and are without a molar plate, its place being taken by a close group of several coarse conical teeth, probably intended for crushing. The maxillae have complex heads with unusually large, fleshy laciniae, possibly adapted for lapping up liquids. They inhabit wet, dead leaves and moss in swampy woods, and often come out on the snow in large numbers. Compared with other species, they are poor jumpers, but they can run actively enough. Whatever else they may eat, *Achorutes socialis* Uzel is one of their natural foods. I once saw several of them on the snow in the open seizing individuals of *A. socialis* and dragging them around deliberately while steadily chewing at them. *A. socialis* were out in great numbers that day and here and there among them was an odd *I. macnamarai*, who did not appear to be actively hunting for prey, but whenever he blundered on an *Achorutes*, he caught it and proceeded to eat it. But owing to their minute size and secretiveness, it is practically impossible to make an intimate and sustained study of any of the Collembola in their habitat, and the food habits of *I. macnamarai* were mostly observed in vials where the specimens were kept with small pieces of damp, rotten wood to provide the moisture so necessary to all these thin-skinned insects.

They are very aggressive and immediately attack any other Collembolan enclosed in the vial with them, grasping it in their jaws and beginning to eat it at once without the formality of a preliminary killing. If half a dozen *Achorutes socialis* are placed in a vial with four or five *I. macnamarai* of an evening, there will remain of the prey in the morning only a few crushed bodies and pieces of legs. A large, steel-blue *I. macnamarai*, sullen and replete, resting motionless in a crevice surrounded by dismembered fragments of his victims, recalled a picture that used to thrill my childhood of an ogre sitting on a rock with bones and skulls scattered around him. Curiously enough, until they are actually seized, the *Achorutes* show no particular fear of the *Isotomas*, and pursue their occupations among their enemies, seemingly quite unconscious of danger.

Under normal circumstances the relations of *Isotoma macnamarai* among themselves are fairly friendly. I have seen a small one come up to a large one resting on the wood, and amicably touch antennae with him for a few moments and then pass on. When a second small visitor approached, however, and tried to repeat the antennal greeting, the stationary one made a savage snap at him like an angry dog, and the little fellow raced away in a panic to the bottom of the vial and hid in a crevice. Cannibalism is practised only when other food

fails. Vials containing *I. macnamarai* alone, where an *Achorutes* would have not lasted five minutes, were under observation for three days before one individual was seen eating another. Might is right in this primitive society, and when cannibalism does set in the smaller ones are always eaten first. Thus the first victim I observed was a small olive-green individual, with its head off and its body chewed into two pieces. Most of the thorax was devoured and a large steel-blue individual was gnawing at the abdomen. He acted very like a dog eating a carcass, except that he did not use his feet to hold down the prey. Presently, he left the body, and picked up the head in his mouth, carried it a short distance and began to chew at the under-side of it. Then in a few minutes he dropped it and moved away, apparently satisfied. I noticed that the soft parts of the head had all been eaten out, and nothing but the hard, chitinous shell was left.

Although rapacious enough, it is not probable that *L. macnamarai* could ever be used to combat any of the injurious species. Like most of the Collembola, it is very sensitive to any lack of moisture in its surroundings, and it is extremely doubtful if it could ever be inured to the drier habitat occupied by *Sminthurus hortensis* and other harmful kinds.

TWO NEW SPECIES OF COELAMBUS (DYTISCIDAE, COLEOPTERA)

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The two species of *Coelambus* described below appear to be new.

***Coelambus salinarius* sp. nov.**

Elongate, slightly obovate. Elytra very pale flavotestaceous, the thorax slightly darker, especially on the disk, the head still more rufous, rarely slightly clouded posteriorly. Body beneath black. Underside of thorax, pale. Clypeus finely margined, sometimes with a tendency to interruption at the middle.

Male.—Surface shining. Head under high power, finely alutaceous, finely and sparsely punctate. Antennae and palpi pale, the former with outer joints sometimes lightly and increasingly infusate at tips, the terminal joint always largely dark.

Thorax almost exactly twice as wide as long, widest at or near base, finely but distinctly margined at sides, hind angles varying from slightly obtuse to right. Apex rather deeply emarginate with acute, prominent angles. Surface polished, finely and sparsely punctured on disk, with a few coarser punctures at base and apex and less obviously at sides. The basal margin, usually only on median area, narrowly blackish, the apical margin usually brownish.

Elytra viewed from above form obtuse angles with thoracic sides, in profile ascending rather gradually, their angle with thorax a little more than right. They are polished, but finely and densely punctured with a few coarser punctures especially basally and on the second black vitta. Each elytron with the suture narrowly and four vittae brownish black, the latter each more or less widening apically but not attaining either base or apex; 1 and 3 abbreviated basally, 2 extending furthest apically and bent outward at tip, 4 and especially 3 with a tendency to disintegration or to disappearance. There are also sometimes a few black spots or dashes at edge of disk which appear to indicate another vitta.

Body beneath shining, but finely sculptured with areolae, which become elongate and strongly transverse on the abdominal segments, and on the metasternum near the middle coxae. Metasternum with a few punctures which are coarser than those on the elytra. Coxal plates rather finely punctured medially, with a slight tendency to rugosity externally, the anterior and posterior margins widely smooth except for the minute areolae. Abdominal segments sparsely and finely punctate, the first and second most coarsely so. A median row of single, large punctures bearing long setae on 2nd, 3rd and 4th segments. Several long setae on prosternal declivity.

Legs pale. Anterior tarsi rather broadly dilated, the 2nd joint very slightly wider than the 1st. The anterior claw somewhat swollen at base, much curved and about two-third as long as the posterior. The posterior claw less bent, thickest and viewed from above, distinctly curved towards its fellow. (Fig. 1).

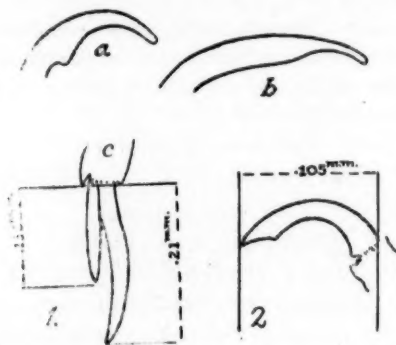


Fig. 1.—*C. salinaris* sp. nov., ♂ foretarsal claws, a, anterior; b, posterior; c, claws as seen from above.

Fig. 2.—*C. falli* sp. nov., ♂ foretarsal anterior claw.

Length 4.26 mm.—5.14; width 1.9 mm.—2.38; (holotype 4.29 x 2.05). *Female*—Either shining and as in male; length 3.66 mm.—4.51, width 1.72 mm.—2.11, (allotype 4.51 x 2.02); or dull, the smaller punctures increased in size and separated by only about one-third of their own diameter, a little larger along basal margin of elytra. Large punctures wanting. Colour as a rule paler.

Length 4.00 mm.—4.60, width 1.85 mm.—2.15, (morphotype 4.00 x 1.85).

Holotype; male, Baldur, Manitoba, 22|VII|22.

Allotype; shining female, Baldur, Manitoba, 29|VII|22.

Morphotype; dull female, Baldur, Manitoba, 22|VII|21, (slightly teneral but compared with type of *fastidiosus*).

This interesting species, remarkable for its restricted habitat—it has been found only in a small alkaline lake—and for the dimorphism of its female, is distinguishable by its vittate elytra and margined clypeus from all our known species except *masculus* Cr. and *fastidiosus* Fall.

From the former the male may be told with certainty by the foretarsal claws—broadly laminiiform, very long, and dilated in middle in *masculus*—and both the male and shining female by the series of coarse punctures on the second black vitta.

The dull females are much alike, but *masculus* is a little broader in

proportion to its length, being almost exactly twice as wide as long. Further, the side margins of the elytra meet the sides of the thorax in a much more gradual curve in *salinarius* than in *masculus*. The clypeal margin in *masculus*, if one may judge from a single specimen, is narrower and better defined and the clypeus is more rounded and extends further forward than in *salinarius*.

There is a possibility that this species may prove to be *fastidiosus*, known only by the unique female type, as the dull females resemble it very closely. Dr. Fall was kind enough to compare the morphotype with his type of *fastidiosus* and pronounces it less broadly oval with differently shaped thorax. When the male of *fastidiosus* is discovered, it will be easy to reduce *salinarius* to the synonymy if necessary.

Besides the types there are in my series several hundred paratypes.

Types in my collection. Paratypes in the Canadian National Museum, British Museum, United States National Museum, and in the collection of Dr. H. C. Fall, Mr. Chas. Liebeck, Mr. C. A. Frost and Mr. Norman Criddle.

***Coelambus falli* sp. nov.**

Elongate oval, dark rufo-testaceous in male, less red in female, thorax and especially head a little darker. Body beneath black, under side of thorax pale. Clypeus not margined. The elytral punctation of two sizes, but not showing much disparity.

Male—Shining. *Head* rather finely punctured anteriorly, much more coarsely and closely posteriorly, and especially angularly from base of head through the foveae leaving a small median area sparsely punctured. Antennae and palpi rufo-testaceous, outer joints darker.

Thorax twice as wide as long, apex not four-fifths as wide as base, sides diverging for about two-thirds of distance from apex, then gradually curving to base, head narrow but distinct. Rather coarsely and densely punctured, especially apically, basally, and medianly along a dark cloud which joins the narrowly dark basal to the dark apical margin, the basal margin slightly rugose.

Elytra coarsely and densely punctured throughout, the smaller punctures being about one-half to two-thirds the diameter of the larger, the punctation on apical third being approximately equal. Each elytron with the suture and five vittae brownish black. The sutural vitta expands outwardly at base and meets the second vitta. None of the others attain the base. The fifth vitta is at the edge of the disk and in the holotype is visible only in the apical half of the elytra.

Body beneath shining except hind margin of coxal plates, which show minute areolae, coarsely punctured on metasternum, coxal plates, and first and second abdominal segments, the punctures showing a tendency to become canalliculate at sides of coxal plates. Remaining segments of abdomen less coarsely punctured.

Legs rufo-testaceous. Front tarsi with joints rather widely dilated but short, second distinctly wider than first. Claws rather short, subequal as to length. Anterior claw almost semicircularly curved for over half its length, thence obliquely truncate to an acuminate point. Posterior claw thin and weak. (Fig. 2).

Length, 4.32, width 2.04.

Female—Upper surface finely alutaceous.

Head moderately shining, coarsely punctured, median area equally so.

Thorax dull, rather coarsely and not very regularly or closely punctured.

Elytra dull. The disparity in size of the punctures is less marked than in the male, the third vitta joins the second basally, the fourth reaches the basal margin and expands, especially outwardly, and the fifth can be traced almost to the basal margin.

Body beneath more closely punctate and more decidedly canaliculate on coxal plates, than in the male, the minute areolae visible on the abdomen. The extreme tip of last ventral testaceous.

Length 4.55, width 2.38.

Holotype; male, Beaver Island, Charlevoix County, Michigan, 7|IX|22 and bears number 103.

Allotype; female, Beaver Island, Charlevoix County, Michigan, 31|VIII|22 and bears number 63.

Both specimens were taken by Mr. M. H. Hatch, who has generously permitted me to retain them.

This species falls in couplet 16 of Dr. Fall's key but cannot possibly be mistaken for either of the species there given.

The difference in size of the elytral punctures is, however, not as noticeable as in many other species and if it should be overlooked the difference in color, markings, etc., will separate it from *semivittatus* and the male claws as well as other characters from *hudsonicus*, *unguicularis* and *oregonus*.

This rare species is dedicated to Dr. H. C. Fall, to whose work all Coleopterists owe so much, and to whom I, in particular, am very greatly indebted.

A NEW SPECIES OF NOTHOSYMPYCUS (DOLICHOPODIDAE) WITH SYNOPSIS OF CANADIAN SPECIES*

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***Nothosympycus tarsalis* n. sp.**

Arista simple, slender, front purple or violet, basal third of the second joint of the middle tarsi swollen on posterior side and bearing three to five long, fine black hairs, the apex of the basitarsus with similar hair and another behind the apex of the fourth joint, the last two joints with moderately long, fine, ciliate hairs behind; third joint of front tarsus one-third longer than the fourth, which is distinctly longer than the fifth; middle femora with one pre-apical bristle in front and behind and a small one beneath; posterior femora with three or four long fine hairs on antero-ventral surface, the stronger pre-apical bristle directed obliquely downward and appearing to be associated with them; posterior tibiae with long, fine cilia on basal third of postero-ventral surface.

Length, about 2 mm. *Male*. Face silvery white elongate triangular, about one-third as wide above as its length; front purplish, violet, or bluish violet, wholly polished. Occiput greyish white pollinose, blackish above, the occipital cilia black, the cilia on the lower two-thirds pallidly yellowish. Antennae black, the first joint as long as the third or slightly longer, slender, the second

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

slightly wider than long, third obtusely rounded apically, very slightly tapering from the base, but still somewhat oval, its base flattened; arista slender, its basal segment not well differentiated, but reaching almost to the apex of the antennae. Palpi usually hidden, but yellowish; proboscis yellow or brownish.

Mesonotum chiefly bluish, more or less greenish in front and laterally, covered with brownish pollen, which only partially conceals the metallic ground. Pleura blue green with thin whitish pollen, only traces of yellow above the hind coxae. Scutellum concolorous with mesonotum, its apex not paler.

Coxae and legs yellow; front coxae with white hairs and one or two black ones at apex. Posterior femora slightly brownish apically above, their tibiae becoming of the same color or even quite brownish on the apical half, their tarsi blackish; last joint of front tarsi, last four of the middle tarsi, except swollen part of the second, the tip of the first and the last joint of the front tarsi and narrow, obscure apices of the first four joints, brown or brownish. Legs simple, except as previously described.

Wings cinereous, the last section of the fifth vein about three times as long as the posterior crossvein, the wing slightly widened basad of the apex of the fifth vein and with a very shallow, broad emargination behind the crossvein. The anal vein is extremely close to the posterior margin of the wing and is obliterated behind the apex of the first vein. Squamae yellow, their cilia appearing obscure brassy yellowish or black in certain lights. Halteres yellow.

Abdomen greenish black with more or less bronze reflections, the second segment except the very narrow more or less brownish apex, the third except the broader incomplete apex and the venter yellowish. Sometimes the third segment may have only the sides yellow. Pile all black. Outer filaments of hypopygium very short, yellow, with black hair, the inner slightly larger, black, the hypopygium black with a blue-green reflection. The genital lamellae are seldom readily seen.

Female. Face wider below, where it is two-thirds as wide as above; at the upper point about the same width as in the male, white pollinose. Antennae shorter, the third joint not longer than broad, sub-orbicular.

Legs simple, paler than in the male, the front tibiae with an apical condensation of short yellow hairs on ventral side; on the posterior tibiae are six to eight, sparsely placed, small, postero-ventral bristles on basal three-fourths. Last four joints of the tarsi more or less browned, usually only slightly so, except the last joint, the apices of the segments usually slightly darker.

Last sternite blackish. Second and third abdominal segments usually with only the basal half yellowish, and even they are more or less brownish in the middle, the first segment more or less yellow, the third sometimes with a yellowish lateral basal triangle.

Holotype—♂, Orillia, Ontario, July 15th, 1923 (Curran); No. 629 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—14 ♂, 1 ♀, same data.

Allied to *frontalis* Loew, but the third joint of the front tarsi is longer than the fourth, the mesonotum is more shining, and the middle tarsi are quite different.

The genera *Sympycnus* and *Nothosympycnus* are not natural ones, the

males of the former having the first joint of the front tarsus longer than the second while in the latter it is shorter. The following keys will aid in determining the species so far recorded from Canada.

SYNOPSIS OF THE SPECIES OF NOTHOSYMPYCNUM (MALES)

1. Front tibiae considerably incrassate; arista remarkably thickened, flat, widest sub-apically (Ont.) *fortunatus* Wh.
Front tibiae slender; arista with a short apical lamella or tapering to apex... 2
2. Arista with apical lamella (Man.) *nodatus* Lw.
Arista tapering to apex (Ont.) *tarsalis* Curran

SYNOPSIS OF THE SPECIES OF SYMPYCNUM (MALES)

1. Front coxae chiefly black (Alta.) *cuprinus* Wheeler.
Front coxae wholly yellow 2
2. Pulvilli of the front legs together as large as the fifth tarsal segment; posterior tarsi slightly compressed and with rather stout hairs on postero-dorsal surface (Alta.) *marcidus* Wheeler
Pulvilli small, not conspicuous; posterior tarsi cylindrical, slender 3
3. Posterior tibiae broadly blackish apically (Ont.) *canadensis* V.D.
Posterior tibiae all yellow, at most only slightly tinged with brownish apically (Ont., Que.) *lineatus* Loew.

NOTHOSYMPYCNUM AND SYMPYCNUM (FEMALES)

1. Front coxae blackish; front and hind femora largely blackish (Alta.)
S. cuprinus Wheeler
Front coxae yellow or whitish 2
2. Sternopleura practically wholly yellow (Ont.) *N. fortunatus* Wheeler
Sternopleura over half (usually all) blackish 3
3. Front tibiae with a row of dense, tiny black cilia on postero dorsal surface 4
Front tibiae without these cilia (Ont.) *N. tarsalis* Curran
4. Front basitarsus distinctly more than half as long as the front tibiae (Ont., Que.) *S. lineatus* Loew.
Front basitarsus distinctly less than half as long as the front tibia (Alta.)
S. marcidus Wheeler

DESCRIPTIONS OF NEW HYMENOPTERA IN THE CANADIAN
NATIONAL COLLECTION, OTTAWA

BY HENRY L. VIERECK,

Ottawa, Ont.

ICHNEUMONOIDEA

Ceratophygadeuon new genus

Presumably related to *Leptodemas* Foerst. and *Oxytaenia* Foerst. which it may be assumed have a simple face, whereas in the present genus there is a median, almost conical horn at the base of the face that has its upper declivity practically on the antennal line. In the first tergite this genus agrees with Foerster's description of this tergite in *Leptodemas* but the posterior aspect of the propodeum is not the same as in *Leptodemas* but answers the description of this part given by Foerster under *Oxytaenia*. Clypeus bituberculate at apex.

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa, Ont.

Ceratophygadeuon taeniatus n. sp.

Female. Length 6 mm.; black, head mostly polished, closely punctured, clypeus appearing impunctate, mandibles mostly reddish, palpi stramineous, antennae blackish except for the apical edge of the second to sixth joints and base of third joint, which are pale coloured, sixth and tenth joints partly whitish, the joints in between mostly whitish partly stained with brown, joint one of flagel apparently as long as joint two or a trifle longer; tegulae castaneous, wing base whitish, wings brownish with darker veins and stigma, the latter pale, whitish at base and apex, legs almost uniformly reddish, the hind femora and tibiae, however, more or less tipped with fuscous, hind tarsi more or less suffused with fuscous; areola decidedly wider at apex than at base but obviously longer than wide at apex; tergum of abdomen mostly reddish, first tergite black, membranous portion of tergites from yellowish to stramineous, fifth tergite with a fuscous apical margin, sixth tergite fuscous, seventh tergite fuscous with a yellowish margin that is widest in the middle, sheaths of the ovipositor barely exerted.

Holotype—♀, Hull, Que., Canada, June 6, 1903, (W. H. Harrington); No. 751, in the Canadian National Collection, Ottawa.

SERPHOIDEA

Telenomus alsophilae n. sp.

The female appears to be related to *T. gnophaeclae* Ashm., *T. californicus* Ashm. and *T. gracilicornis* Ashm., from which it differs in the smooth and polished first and second tergites. The male appears to be related to *T. spilosomatis* Ashm. from which it differs, at least, in having dark legs.

Female. .59 mm.; black, polished, head and thorax with setigerous, well separated punctures, head seen from above twice as wide as long antero-posteriorly, greatest length of eyes: least width, nearly :: 8:5, distinctly but sparsely pubescent, mandibles dark, brownish, palpi dark, antennae 11-jointed, blackish, scape a little less than half as long as the remainder of the antennae, length of joint 1 of the flagel: length of the pedicel :: 2:3, joint 2 of the flagel apparently a little longer than joint 1, joints 3 and 4 of the flagel nearly globular, joints 5-9 inclusive of the flagel, forming a club in which joint 5 is the shortest and wider than long, and not much longer than the preceding joint of the flagel; legs mostly blackish, tarsi stramineous, wings including veins nearly colorless, with the postmarginal vein poorly defined and apparently distinctly longer than the stigmal vein; abdomen polished, length of second tergite: its width :: 12:22.

Male. Length, a little shorter than the female. Antennae 12-jointed, (mounted in balsam) with the coxae brownish, rest of legs stramineous, pedicel a little longer than joint 1 of the flagel, joint 2 of the flagel apparently as long as the pedicel, joint 3 of the flagel apparently as long as joint 2, joints 4 to 9 inclusive, nearly globular, the terminal joint conical and almost exactly twice as long as the preceding joint.

Holotype—♀, mounted on point, Kentville, N.S., June 22, 1917, (No. 345, W. H. Brittain); No. 808, in the Canadian National Collection, Ottawa. Reared from eggs of the fall canker worm (*Alsophila pometaria*).

Allotype—♂, with the same data as the holotype except that the date is June 23, 1917.

Paratypes—♀♀, ♂♂, mounted on slide, with the same data as the allotype.

VESPOIDEA

Odontophotopsis crassus n. sp.

Related to *O. conspicuus* Blake.

Male. Length 12 mm.; flagel uniformly dull stramineous, legs uniformly stramineous, hind and mid femora darkened toward apex, front without a furrow, postocellar line: lateral ocellar line :: 11:5, malar line: lateral ocellar line :: 2:5; furrows of the dorsulum extending nearly to the anterior margin, metanotum costate, mesopleura polished and nearly impunctate on the depressed part, tooth on each side of mesolcus robust, triangular in outline when seen from behind, stronger than in *O. obliquus* Vier., third submarginal cell and second recurrent vein faintly outlined, that part of the metapleura nearest the hind coxae nearly sculptureless; second sternite without a felt-like line corresponding to the felt-like line on the second tergite, pygidium much wider than in *O. obliquus* Vier. and apparently impunctate.

Holotype—♂, Oliver, B. C., July 24, 1923, (E. R. Buckell); No. 754, in the Canadian National Collection, Ottawa.

Paratype—♂, Redonde, California, June 30, 1919, (Am. Mus. Nat. Hist.).

Odontophotopsis obliquus n. sp.

Related to *O. brevicornis* Fox.

Male. Length 12 mm.; reddish-stramineous, flagel more or less pale stramineous stained with brown, the scape concolorous and paler than the remainder of the antennae, legs more or less pale stramineous, mid and hind femora partly blackish, stigma dark, translucent, veins pale stramineous, membrane yellowish, most hairs whitish or almost colorless; head polished, with well separated punctures that are closer on the front than on the vertex, front with an indistinct furrow between the antennal line and the anterior ocellus, postocellar line: lateral ocellar line :: 9:4, eye nearly contiguous to the mandibular joint, clypeus concave, nearly polished, apparently impunctate except for some marginal setigerous punctures, mandibles decidedly curved, with a strong upper and lower margin, the latter deeply notched, the notch extending inward nearly half the width of the mandible, joint one of the flagel is to joint two as ten is to eleven; prothorax coarsely reticulated, dorsulum polished, with separated punctures, its furrows extending from about one-third the distance from the anterior margin to the posterior margin, scutel sculptured much like the prothorax, metanotum indistinctly sculptured, propleura roughened above, rather smooth below, mesopleura punctured on the depressed part, the bulged part coarsely reticulated, posterior border smooth, polished and punctured, tooth on each side of the mesolcus robust, triangular in outline when seen from behind, second recurrent vein not defined; disc of propodeum with an irregular oblong area and an almost triangular area on the left side of the median enclosure, the rest of the propodeum with great meshes to the reticulation, upper part of metapleura forming a polished channel, the lower part coarsely sculptured; petiole obviously longer than wide at apex, its punctures large but not sharply defined, second tergite with finer, better defined punctures than the first, with a long, felt-like line near the lateral margin, the analogous felt-line on the second sternite nearly spot-like, pygidium smooth, not margined, punctured near apex.

Holotype—♂, Oliver, B. C., July 24, 1923, (E. R. Buckell); No. 753, in the Canadian National Collection, Ottawa.

NEW CANADIAN EPHEMERIDAE WITH NOTES, II*

BY J. MCDUNNOUGH,

Ottawa, Ont.

(Continued from page 98.)

***Cloeon implicatum* n. sp.**

Male. Eyes (living) olive-green, (dried) deep olive-brown: thorax dark black-brown with sutures on posterior portion of mesothorax marked with ruddy-brown, laterally below the wings shaded with pale yellow and ruddy, sternum brown, paler than dorsum; abdomen with segments 2-7 dorsally pale olive-brown, semi-hyaline, shaded considerably with ruddy laterally (and on 6-7 dorsally) and with the segmental incisures pale yellowish; posterior segments bright ruddy brown; traces of a fine broken black stigmatal line. Ventrally abdomen pale yellowish, forceps and setae whitish, latter with faint ruddy intersegmental banding basally. Legs pale yellowish, fore femur shaded with smoky, fore tibia smoky on basal third and with a smoky longitudinal dash before apex, joint dusky; hind tibiae slightly dusky at base, wings hyaline.

Holotype—♂, Waterton Lakes, Alta., July 22, (J. McDunnough); No. 696 in the Canadian National Collection.

Paratypes—2 ♂, same locality and collector, July 24, 25.

This species is close to *ingens* McDunnough but is paler and ruddier in coloration and the legs are yellowish, not entirely smoky, with rather characteristic marking on the fore tibia. There is also a single ♂ from Vernon, B.C., August 8th, (D. G. Gillespie) before me, which, apart from its considerably smaller size, agrees with the above description.

***Cloeon inanum* n. sp.**

Male. Smaller and paler than the preceding species. Eyes (dried) dull orange. Thorax olivaceous brown, shaded with pale yellowish at base of wings and posteriorly. Abdomen pale yellowish, semihyaline on segments 2-6 dorsally, with faint ruddy patches laterally above the spiracular line, which is marked in black; segments 7-9 dorsally bright ruddy-brown, 10 pale yellow. Ventrally pale yellowish with forceps and setae similarly colored. Legs pale yellowish with faint smoky tinges on the fore femora and tibiae. Wings hyaline. Length of body 6 mm.; of forewing, 6.5 mm.

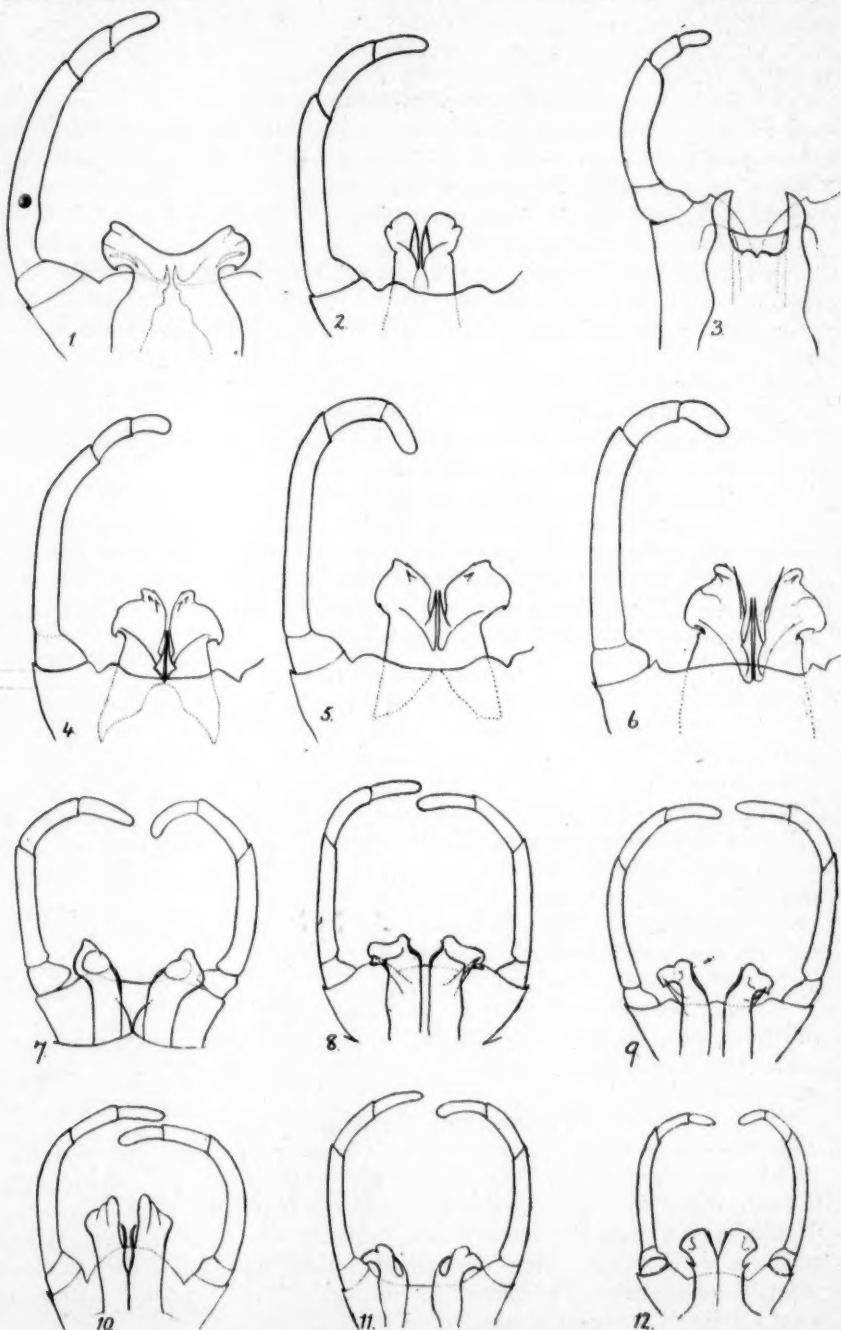
Holotype—♂, Waterton Lakes, Alta., July 23, (J. McDunnough); No. 697 in the Canadian National Collection.

Paratype—♂, same data.

The specimens of the above two species were taken singly, mostly as subimagos flying some distance from the water: there is apparently a good representation of large *Cloeon* species in the west but they seem difficult to secure in numbers.

***Pseudocloeon turbidum* n. sp.**

Male. Turbinate eyes large, circular, considerably larger than in *dubium* Walsh, red-brown (living), deep red-brown to blackish (dried); thorax shining blackish, tinged with ruddy in the lateral sutures below the wings. Abdomen dorsally entirely dark olivaceous brown, ventrally pale yellowish-white, forceps and setae white. Legs with all femora dark smoky brown, tibiae and tarsi pale yellowish-white, tinged with smoky on forelegs. Wings hyaline. Length of body 4 mm.; of forewing 4 mm.



NEW CANADIAN EPHEMERIDAE

Female. Head, thorax and abdomen light to ruddy ochreous dorsally, thorax with posterior dorsal portion and lateral sutures pale yellowish; ventrally the abdomen is pale yellowish-white. Legs dull yellowish-white, the femora, especially of the forelegs, deeper in color, ochreous brown.

Holotype—♂, Waterton Lakes, Alta., July 24. (J. McDunnough); No 694 in Canadian National Collection.

Allotype—♀, same locality and collector, July 22.

Paratypes—58 ♂, 25 ♀, same locality and collector, July 22-26.

The genus *Pseudocloeon* was erected by Klapalek for species without hind wings and with paired intercalaries on primaries. It includes the North American species, *dubium* Walsh, *punctiventris* McDunnough, *chlorops* McDunnough and *virilis* McDunnough. From these species *turbidum* is easily separable by the entirely dark dorsum of the abdomen.

***Pseudocloeon virilis* McDunnough**

The description of this species (Canadian Entomologist, 1923, p. 46), was based on a single Ottawa male. A long series of both sexes is now before me, captured on June 12, by Mr. R. Ozburn, a few miles up the Ottawa river on the Quebec side. The males vary considerably in size; the type happened to be one of the large specimens, the smallest in our series having a wing length of scarcely more than 4 mm. Features in the original description which are more or less inconstant are,—the black tracheal markings in the stigmal area, the ruddy medio-ventral dots on abdominal segments 5 and 6 and the ruddy tinge on the segmental incisures. The yellow streak on lateral edge of mesonotum may be reduced to an anterior dot of yellowish. Characteristic features seem to be the red subdorsal dots and the red-banded femora, the bands frequently showing on the foreleg as well. A feature overlooked in the description is the presence of a lateral row of minute brown patches, one to a segment, placed just above the spiracular area. In poorly marked specimens, some at least of these spots are visible. The eyes are noticeably larger than in *dubium* Walsh, from the Rideau river, although there appears to be considerable variation in size in the dried series before me.

The ♀ of *virilis* has the thorax light brown with the posterior elevation of the mesothorax light ochreous, often tinged with greenish. The abdomen (as far as can be told from dried specimens, which are usually discolored) is dorsally pale brown, with posterior segments opaque and more distinctly colored; traces of the subdorsal red dots can be observed in some specimens. Ventrally the abdomen is pale ochreous with paler posterior segmental margins, except laterally, where for a short distance they are brown; there are sometimes traces of brown shades below the spiracular flange. Legs yellowish with brown fore femur; orange-red banding on four posterior femora distinct. Wings hyaline with pale venation.

The ♀ is very close to that of *dubium* Walsh, but can be generally differentiated by the red banding of the femora which in *dubium* is mostly entirely lacking or, if present, is quite faint.

***Ameletus vernalis* n. sp.**

Male. Head and thorax deep black-brown, the sutures partially marked with ochreous. Abdomen with segments 2-6 translucent, dull greyish-white, 7-10

opaque, pale ochreous, with a dorsal series of deep purple-brown subtriangular patches, based on the posterior margin of each segment with the apex reaching quite or nearly to anterior margin; a similar series of lateral brown patches, leaving the pale ground color showing as triangular patches based on the anterior margin of segments and hardly extending to posterior margin; segment 9 dorsally almost entirely brown. Ventrally segments 2-6 pale grey-white with faint traces of medio-ventral brownish spots connected by a fine line or stripe and with the usual lateral row of depressed oval spots more or less visible; segments 7-10 opaque, pale ochreous, in addition to the above mentioned spots they show brown triangular patches based on the posterior margin on segments 7 and 8; segments 9 and 10 are largely brownish with the exception of the posterior rounded projection of segment 9, which is pale ochreous; forceps deep smoky. Wings hyaline with an apical brown shade on primaries and a slight brown tinge at base of R_3 where there is a collection of six crossveins; veins and crossveins brown except 3 or 4 crossveins on costa just beyond the bulla which are pale and indistinct; beyond these the costal crossveins anastomose forming a series of small costal cells with larger ones below them. Legs with femora black-brown, the color of fore femur being deepest, a slight ochreous tinge at base and apex and an ochreous line along upper edge; fore tibiae and tarsi black, posterior ones light brownish.

Female. Head ochreous, shaded heavily with brown behind the ocelli and with a central longitudinal blackish line on vertex. Thorax more shaded with ochreous than in male. Abdominal maculation similar but generally confused, ventrally the segments are largely tinged with purplish brown. Legs rather paler than in male, the four hind femora being largely ochreous. Length of body 12 mm.; of forewing 12 mm.

Holotype—♂, Oliver, B. C., April 27, (C. B. Garrett); No. 749, in the Canadian National Collection, Ottawa.

Allotype—♀, same locality and collector, April 28.

Paratypes—1 ♂, 12 ♀, same locality and collector, April 26, 27, May 5, 9, 11, 16 and 21.

The ♂ genitalia (fig. 3) are rather similar to those of *velox* Dodds but show a ventral spine below the penes not present in Dodds species (l. c. Pl. VIII, fig. 17).

Genus *Heptagenia* Eaton

The correct placing of our numerous North American species of Heptageninae in the various genera adopted by Eaton (*Ecdyonurus*, *Rhithrogena*, *Iron*, *Ephorus*, *Cinygma*, *Heptagenia*) has always been a matter of difficulty, largely due, it seems to me, to the fact that Eaton has used as a primary means of generic separation the comparative lengths of the first and second tarsal joints of the hind tibiae. These joints in many instances are very short and difficult to compare accurately in dried specimens, and, while Eaton's association of our American species was correctly made, later attempts to follow his system of classification have resulted in numerous wrong associations.

As a primary means of separation of the above mentioned genera Needham's key in Bulletin 86 of the New York State Museum, p. 23 (1905), based on the length of the first joint of the male fore tarsus, seems to offer much

better possibilities for accurate placing and correct association of species. An examination of our species in this family shows that they fall, roughly speaking, into three main groups, as follows:—(1) first joint of male fore tarsus very short, generally only one-sixth the length of the second, occasionally one-third its length (*Heptagenia*, *Rhithrogena*); (2) first joint moderate in length, generally about one-half the length of second joint (*Ecdyonurus*); (3) first joint long and equal to (*Epeorus*, *Iron*), or slightly shorter than, the second joint (*Cinygma*). The type of δ genitalia more or less bears out the above grouping, especially in the second group, which contains species with the apices of the penes broadened laterally, the whole lobe being L-shaped.

Banks in his notes on the eastern species of *Heptagenia* (1910, Can. Ent. 197) makes no attempt at a separation of species along the above lines except in the case of three new species which he tentatively places under *Epeorus*.

Clemens (1913, Can. Ent., 249, 329), (1915, Cont. Can. Biol. 117, 133) has reversed the correct usage of the generic terms *Heptagenia* and *Ecdyonurus*; his criticism of Needham's key (l. c. p. 119) is incorrect and probably based on a misidentification of *H. flavescens* Walsh, the type species of *Heptagenia*, which is recorded in the above papers from Georgian Bay. A reference to Clemens description of so-called *flavescens* (l. c. p. 135) shows clearly that it is not Walsh's species that he had before him at the time. Walsh distinctly states (1863, Proc. Ent. Soc. Phil. II, 206) that the first tarsal joint of the δ foreleg is "much shorter" than the second in both *flavescens* Walsh and *cruentata* Walsh.

Ulmer (1920, Stett. Ent. Zeit. 144), who follows Eaton's characters in separating the various genera but who is obviously unacquainted with many of the North American species, places a heterogeneous assemblage of species under *Heptagenia*; many of these will fall into *Ecdyonurus*.

At the present time I am using the generic term *Heptagenia* for all those species with short first fore-tarsal joint, and am discarding the genus *Rhithrogena*, based on a European species, *semicolorata* Curtis, until such time as material of the genotype can be studied. It is probable that further subdivisions within the above limits may be necessary but these can safely be left for a later date.

The following species fall into *Heptagenia* as above characterized:—*flavescens* Walsh, genotype; *cruentata* Walsh, *marginalis* Banks (unknown to me); *maculipennis* Walsh; *pullus* Clemens; *lucidipennis* Clemens; *jejuna* Eaton (*fusca* Wlk.); *brunnea* Hag.; *elegantula* Eaton; *coxalis* Banks (very close to *elegantula*); *manifesta* Eaton, *vitrea* Wlk. (according to Eaton); *robusta* Dodds (from Colorado, unknown to me). As certain of the above species have been heretofore unknown or misidentified I offer a few notes on some of them together with descriptions of several new species.

***Heptagenia flavescens* Walsh.**

Banks records this species (1910, Can. Ent., 200) from St. Anthony Park, Minn. In the Canadian National Collection are 3 δ , 1 η and 2 sub-imagoes from Aweme, Man. The species is a large yellowish one with a brown dorsal band extending the entire length of the body, broadening somewhat on the mesothorax and becoming reddish on the posterior abdominal segments. The wing venation is quite characteristic, the costal crossveins being faint in the basal half of the wing, becoming thicker and darker in color in the apical section, where

all the veins are distinctly fuscous, just as stated by Walsh in his description, which is quite accurate. The first foretarsal joint in the δ is about one-quarter the length of the second and on the hind tibia the first joint is distinctly shorter than the second. I figure the δ genitalia (fig. 1). As stated above, Clemens' record of this species from Georgian Bay, Ont., is erroneous.

Heptagenia reversalis n. sp.

Male. Very similar to *flavescens* but smaller and with paler dorsal area. Light yellow, head shaded with reddish, and with light brown dorsal area on thorax and abdomen, this color paling on the posterior abdominal segments; the overlapping sections of the segments appear darker, giving the appearance of rings. Legs yellow, femora with median and apical bands of reddish, fore tibiae tipped with smoky, first foretarsal joint one-third the length of second. Wings hyaline with entire costa of forewing tinged with yellow; costal crossveins distinct, black in basal half of wing, becoming pale and indistinct in apical section (the reverse of *flavescens* in this respect); other veins and crossveins fine, blackish, paler at base of wing. Length of body 8.5 mm.; of forewing 10 mm.

Holotype— δ , Aweme, Man., June 22, (R. M. White); No. 739, in the Canadian National Collection, Ottawa.

Paratype— δ , same locality and collector, June 28.

I had at first considered this species to be *cruentata* Walsh but it does not agree with the description either in regard to the color of the legs (on which Walsh lays considerable stress) or in the color of the costal crossveins. In both specimens before me the setae are lacking. The δ genitalia appear in the dried condition very similar to those of *flavescens*.

Heptagenia lucidipennis Clem.

I have specimens before me from both Orillia and Ottawa, Ont.; the first joint on the fore tarsus of the male is about one-quarter the length of the second; on the hind tarsus this same joint is distinctly longer than the second joint and the species would fall on this character into *Rhithrogena*; for the size of the insect the hind tarsal joints are quite long.

Heptagenia inconspicua n. sp.

Male. Head light yellow, the face shaded next the eyes with orange-brown; thorax dorsally pale to dark olive-brown, laterally light yellow; abdomen pale yellow, semihyaline on segments 2-7 with a broad dorsal band of light or ruddy brown (varying in intensity in different specimens) and with the hind margin of each segment opaque, producing an annulate effect; forceps and genitalia pale ochreous. Legs pale yellow, the fore femora and tibiae tipped with smoky brown; first foretarsal joint about one-third the length of the second, first hindtarsal joint longer than the second. Wings hyaline with pale venation, the costal veins in the basal half of wing scarcely perceptible. Setae whitish, slightly annulate with ruddy brown in basal portion. Length of body 4 mm.; of forewing $5\frac{1}{2}$ mm.

Female. Head largely tinged with ruddy brown; otherwise similar to male but paler in dorsal coloration.

Holotype— δ , Treesbank, Man., Sept. 8, (T. Criddle); No. 743, in the Canadian National Collection, Ottawa.

Allotype— φ , Wawanesa, Man., Sept. 22, (R. M. White).

Paratypes—32 ♂, Treesbank, Man., Sept. 8, Oct. 1, (T. Criddle); Sept. 27, (R. M. White); 5 ♂, 7 ♀, Wawanesa, Man., Sept. 22 (R. M. White); 6 ♂, Aweme, Man., Sept. 29, 30, (N. Criddle).

A smaller species than *lucidipennis* and differing in genitalia (fig. 2). It is probably allied to *manifesta* Eaton which is unknown to me; Hagen, however, states of this species (1863, Proc. Ent. Soc. Phila. II, 170, as *debilis* Walsh) that the genitalia are black.

Heptagenia querula n. sp.

Male. Thorax pale ochreous with median dorsal brown band, a faint pinkish patch preceding the posterior mesothoracic protuberance; rear margin of mesothorax and most of the metathorax tinged with smoky brown. Abdomen pale, semihyaline, faintly banded with smoky brown dorsally on posterior portion of segments 2-7; segments 8-10 opaque, tinged with pink dorsally, ventrally pale ochreous. Legs pale yellow, fore femur deeper in color than others, all femora faintly tinged with ruddy at apex and coxae of four hind legs tinged with purplish at base; fore tibiae tipped with smoky; first foretarsal joint in ♂ one-sixth length of second, joint 1 on hind legs slightly shorter than 2. Wings hyaline with costal margin tinged with pale lemon yellow, veins 2 and 3 largely pale yellow, other longitudinal veins fine, dark; crossveins dark, the costal ones being thicker and black with a well defined black bulla.

Female. Pale ochreous, the abdomen often tinted with egg-yellow from the underlying egg-masses; behind the lateral ocelli on the vertex of the head are triangular black patches with faint ruddy tint between them. Wing venation as in male. Length of body 10 mm.; of forewing 12 mm.

Holotype—♂, Aweme, Man., June 14, (N. Criddle); No. 740, in the Canadian National Collection, Ottawa.

Allotype—♀, same locality, June 14, (R. M. White).

Paratypes—4 ♀, same locality and collector, June 4, July 17, 19.

Very similar to *elegantula* which also occurs in Manitoba but differing in much larger size and structural details of hind tarsal joint; the ♀ of *elegantula* has ruddy spots on the vertex of head, not black ones, and a small black spot next the eye on a level with the antennae which is lacking in *querula*; the species must also run very close to the European *sulphurea* judging by Eaton's description but without material before me I am unable to make comparisons.

Heptagenia solitaria n. sp.

Male. Head light-brown, tinged on vertex with ruddy and with a black dash on the face next the eye below the level of the antennae; thorax brown dorsally with a deeper brown median stripe most distinct on anterior portion of mesothorax; laterally the thoracic segments are pale ochreous brown. Abdomen very pale brownish, segments 2-7 semitranslucent and shaded dorsally with purple-brown, this color occupying the posterior half of segments 4-7 and most of segments 2 and 3, causing a somewhat banded appearance; segments 8-10 opaque, light ruddy-brown dorsally, paler ventrally. Forceps ochreous, setae dull ochreous, narrowly banded with brown. Legs pale ochre-brown, all the femora and the fore tibial and tarsal joints tipped with purplish; first fore-tarsal joint about one-sixth the length of second, first joint of hind tarsus slightly shorter than second. Wings hyaline, slightly tinged along costa with pale lemon yellow,

longitudinal veins fine, deep brown except basal half of 2 and 3 which are thickened and pale yellowish; crossveins thicker than other veins, especially along costa, all deep brown. Length of body 9 mm.; of forewing 11 mm.

Holotype—♂, Waterton Lakes, Alta., July 7. (J. McDunnough); No. 741, in the Canadian National Collection, Ottawa.

A much darker species than any others in this group and probably allied to *pullus* Clem.; the ♂ genitalia are of the *elegantula* type.

***Heptagenia adaequata* n. sp.**

Male. Head light ochreous with black dash next the lower corner of each eye and two blackish spots on vertex adjacent to the eyes; the bases of antennae ringed with black; ruddy brown shading at base of median carina and a small spot of similar color on each side of the central ocellus. Thorax pale ochreous, tinged with deeper color dorsally on mesothorax. Abdomen very pale yellowish, semitranslucent on segments 2-7, with narrow deep brown posterior margin dorsally to first eight segments and paler triangular subdorsal patches of brown situated on the posterior margin of each segment; segments 9 and 10 shaded dorsally with light brown. Setae pale, very distinctly ringed with brown. Legs ochreous, base of coxa on four hind legs with a black streak, femora with median and apical bands of purplish, fore tibiae tipped with smoky, first joint of fore tarsus one-fifth length of second, of hind tarsus slightly shorter than second. Wings hyaline, veins fine, blackish, except basal portions of 2 and 3 which are thickened and yellowish; crossveins thicker than other veins, blackish, especially well marked along costa. Genitalia of same type as in the preceding species. Length of body 10 mm.; of forewing 11 mm.

Holotype—♂, Cowley, Alta., June 25. (R. N. Chrystal); No. 742, in the Canadian National Collection, Ottawa.

***Heptagenia simplicoides* n. sp.**

Male. Entirely pale creamy white with abdominal segments 2-7 more or less translucent, clypeus slightly sprinkled with brown dots; the tip of the fore tibia and the first fore tarsal joint and all the claws deep smoky; other joints of fore tarsus slightly smoky. Wings hyaline with pale veins and crossveins. First fore tarsal joint about one-quarter the length of the second.

Female. Similar to male; head either entirely pale or with ruddy shading anterior to the ocelli; slight traces of ruddy shades at base of wings and fore legs. Length of body 7 mm.; of forewing 8 mm.

Holotype—♂, Waterton Lakes, Alta., July 13 (J. McD.); No. 744, in the Canadian National Collection, Ottawa.

Allotype—♀, same locality and collector, July 6.

Paratypes—1 ♂, 1 ♀, same locality and collector, July 18, 24.

Similar to *simplex* Walsh but differing in the length of the first fore-tarsal joint in the male which in *simplex* is fully three-quarters the length of the second.

***Heptagenia maculipennis* Walsh**

The identifications of this species by Needham (1905, Bull. 86, N.Y. State Mus., pp. 51, 57) and Banks (1910, Can. Ent. XLII, 200) are erroneous. Walsh's description clearly calls for a species with the abdominal segments pale yellow, immaculate, with the exception of the posterior segments, which are what

Walsh terms "piceous." Such a species is before me from Aweme, Man., and as it agrees excellently in all other particulars with the description, I have no hesitation in identifying it as the true *maculipennis*. The group contains several closely allied species, very similar in size and in the maculation of the primaries but differing in the color of the abdomen and structural details of the male genitalia. For purposes of comparison I figure (fig. 4) the genitalia of *maculipennis*.

Heptagenia minerva n. sp.

Male. Face pale yellow marked with black along anterior edge; thorax pale lemon yellow with a geminate brown medio-dorsal line extending backward to a point opposite base of wings, laterally with a broad blackish stripe above the bases of the legs; abdomen pale yellow tinged with ruddy-brown dorsally on segments 8-10, and with a series of lateral longitudinal deep brown stripes, continuing the thoracic dark stripe and almost forming a continuous line; these stripes are broadest on segments 2 and 3. Posterior edge of each segment narrowly edged with blackish, which broadens into a small dark patch on the postero-lateral corner below the above mentioned stripe; ventrally immaculate, forceps and setae pale. Legs pale yellow, the femora with a median ruddy and an apical black longitudinal dash on ventral side, fore tarsi and apical half of fore tibiae smoky, first tarsal joint one-quarter to one-sixth the length of the second.

Wings hyaline with fine dark longitudinal veins; crossveins heavier, black-brown in the costal and subcostal interspaces; 3-4 crossveins on costa before bulla, well spaced, crossveins in area of bulla (3-4 in each interspace) close together, the margins more or less coalescing to form dark blotches in both the costal and subcostal interspaces, a similar group of 3 or 4 crossveins in apical area of costa, and a small dark blotch at the furcation of the median vein. Length of body 6 mm.; of forewing 7 mm.

Female. Very similar to ♂, vertex of head margined with black and tinged with reddish; no brown shading posteriorly on abdomen.

Holotype—♂, Ottawa Golf Club, Que., July 16, (R. Ozburn); No. 746, in the Canadian National Collection, Ottawa.

Allotype—♀, same locality and collector, July 26.

Paratypes—3 ♂, Ottawa, Ont., June 11, (J. McDunnough); 2 ♀, same data as Allotype.

This is probably the species determined as *maculipennis* by Banks; the ♂ genitalia are very similar to those of *maculipennis*.

Heptagenia junio n. sp.

Male. Size of preceding species, pale whitish yellow, lateral edge of prothorax and bases of legs slightly marked with blackish, a very faint brownish shade laterally on thorax below wings. Abdomen with segments 2-7 hyaline, faintly margined dorsally with brownish; segments 8-10 tinged dorsally with light brown. Legs pale yellow (fore legs lacking); femora with dark apical streak. Wings hyaline, longitudinal veins mostly pale, crossveins fine, blackish in costal half of wing, those along costa slightly thickened but not nearly so heavily margined with blackish as in the preceding species, the dark margin being confined to the crossveins basad of the bulla; there is no coalescing to form dark streaks and the dark shade at the median fork is wanting.

Female. Very similar to ♂, abdomen slightly yellower and without posterior brown shading.

Holotype—♂, Covey Hill, Que., June 25, (C. H. Curran); No. 747, in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratype—1 ♂, same data.

The ♂ genitalia (fig. 5) are similar to those of *maculipennis* but there is only a single apical spine on the penis.

***Heptagenia hebe* n. sp.**

Male. Size of preceding, face pale yellow with dark anterior margin, vertex of head deep brown. Thorax olive-brown dorsally, shaded slightly with pale ochreous, light yellow laterally and ventrally, with a broad brownish lateral stripe above bases of legs. Abdomen dorsally deep brown with subdorsal series of semihyaline pale elongate streaks which unite on segments 4-6 to form broad dorsal semihyaline patches; lateral edges of segments 2-7 pale smoky, semihyaline; posterior segments tinged with light brown; venter pale yellowish as are also the forceps and setae. Fore-legs pale brownish, coxae and base of femora yellowish, dark streak ventrally at apex of femora, other legs pale yellow. Wings hyaline, faintly tinged with brownish apically, maculation much as in *minerva* with a tendency for the costal crossveins before the bulla to increase in number.

Female. Much paler than the male; pale ochreous to light yellow, with a lateral series of semitriangular brown patches on the posterior section of abdominal segments and generally a fine brown posterior margin.

Holotype—♂, Broadview (vicinity of Hull), Que., July 12, (R. Ozburn); No. 748, in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—3 ♂, 2 ♀, same locality and collector, July 12, 16; 2 ♂, Deschênes, Que., June 30; 3 ♂, 2 ♀, Ottawa Golf Club, Que., July 16, 17, 25; 2 ♂, Aylmer, Que., July 17; 2 ♂, 2 ♀, Hogsback, Rideau River, Ont., June 29; (all above collected by R. Ozburn); 3 ♂, Ottawa, Ont., May 27, June 11, (J. McDunnough); 4 ♀, Hull, Que., June 26, July 5, (Miss Cramp).

Much darker than the two preceding species and with a tendency to an elimination of the pale abdominal areas by a spreading of the brown color. The male genitalia (fig. 6) show much longer spines in the penes than in the other species and approach Needham's figure of the false *maculipennis* (l. c. p. 51), although no central setae, as shown in this figure, have been observed by me.

(To be continued)

RECENT COLLECTIONS OF CANADIAN SPIDERS

BY J. H. EMERTON,
Boston, Mass.

In the summer of 1920, Mr. Fritz Johansen, while exploring the waters of James and Hudson Bays, collected spiders at several stations, in all 22 species.

The species from Moose River and Charlton Island are the common ones of eastern Canada; but farther north toward Richmond Gulf he found *Lycosa pictilis*, *L. albobastata* and *Pardosa furcifera*, which usually occur on mountaintops or in Labrador and Greenland. At Moose Island a new species of *Grammonota* was found (described in the "Canadian Entomologist" for October, 1923). The list of species follows.

MOOSE RIVER ISLANDS, June 28: *Hahnina radula*, male; *Epeira strix*; *Pardosa greenlandica*, male and female.

MOOSE ISLAND (MOOSE FACTORY), July and October: *Grammonota spinimana* n. sp.; *Clubiona canadensis*, male; *Drassus neglectus*; *Pachygnatha brevis*; *Dolomedes sexpunctatus* (from pond).

COAST BETWEEN MOOSE AND ALBANY RIVERS, July: *Pardosa albiceps*; *Pardosa greenlandica*; *Pirata insularis*; *Erigone longipalpis*.

CHARLETON ISLAND, July and September: *Tibellus oblongus*; *Cariarachne versicolor*; *Epeira displicata*; *Clubiona canadensis*; *Pardosa greenlandica*.

CAPE HOPE ISLANDS, East coast of James Bay (about Lat. $52\frac{1}{2}^{\circ}$ N.), Sept. 13: *pardosa luteola*, female.

MOUTH OF SEAL RIVER, East coast of James Bay (about Lat. $54\frac{1}{2}^{\circ}$ N.), Sept. 3: *Erigone longipalpis*.

SOUTH TWIN ISLANDS, James Bay; July 22: *Epeira pataginata*.

EAST COAST OF HUDSON BAY (between Great Whale River and Richmond Gulf), August: *Lycosa pictilis*; *L. albohastata*; *Pardosa greenlandica*, female and young; *P. hyperborea*, female with eggs; *P. furcifera*, female; *P. glacialis*, female; *P. brunnea*.

In the summer of 1922 Dr. C. W. Townsend of Boston visited Gaspé and collected the following species:

On Mt. Albert, Gaspé, from the tree line upward—

| | |
|-----------------------------|-----------------------------|
| <i>Bathypantes alpina</i> ♂ | <i>Pardosa greenlandica</i> |
| <i>Epeira patagiata</i> | " <i>musicicola</i> |
| <i>Lycosa beanii</i> | " <i>furcifera</i> Th. ♂ ♀. |

Gaspé coast from St. Anne des Monts to Chaudreuve—

| | |
|------------------------------|-----------------------------|
| <i>Steatoda borealis</i> | <i>Pardosa greenlandica</i> |
| <i>Ceratinella fissiceps</i> | " <i>xerampelina</i> |
| <i>Helophora insignis</i> | " <i>mackensiana</i> |
| <i>Linyphia marginata</i> | <i>Lycosa pratensis</i> |
| <i>Epeira patagiata</i> | <i>Tegenaria derhamii</i> |
| " <i>nordmanni</i> | <i>Zelotes ater</i> |
| <i>Cyclosa conica</i> | <i>Misumena vatia</i> |

In the summer of 1923 Dr. Townsend visited Grand Manan and collected the following:

HOUSE SPIDERS

| | |
|---------------------------|---------------------------|
| <i>Steatoda borealis</i> | <i>Zilla atrica</i> |
| <i>Epeira sclopetaria</i> | <i>Tegenaria derhamii</i> |

CANADIAN SPECIES

| | |
|---|--|
| <i>Theridion zelotypum</i> (webs in spruce trees). | <i>Pardosa xerampelina</i> |
| <i>Epeira labyrinthea</i> (bog variety). | " <i>mackensiana</i> |
| <i>Gnaphosa brumalis</i> | " <i>hyperborea</i> Th. (Alpine and Arctic bog species). |
| <i>Clubiona riparia</i> (nests in folded leaves of Iris). | |

ALLEGHANIAN SPECIES

| | |
|--|------------------------------|
| <i>Linyphia phrygiana</i> | <i>Pardosa lapidicina</i> |
| <i>Cyclosa conica</i> | <i>Lycosa frondicola</i> |
| <i>Drassodes neglectus</i> | <i>Lycosa lepida</i> |
| <i>Agalena naevia</i> | <i>Phidippus multiformis</i> |
| <i>Dolomedes idoneus</i> (large water spider). | |

In the summer of 1923 Fritz Johansen collected the following on the Island of Anticosti:

| | |
|------------------------------|-------------------------------|
| <i>Steatoda corollata</i> | <i>Pardosa greenlandica</i> |
| <i>Epeira patagiata</i> | <i>Coriarachne versicolor</i> |
| <i>Amaurobius sylvestris</i> | <i>Tibellus oblongus</i> |
| <i>Pardosa greenlandica</i> | <i>Zelotes ater</i> |

In the summer of 1923 Miss E. B. Bryant, of Boston, visited the southern part of Nova Scotia and collected around Barrington the following, besides three new species to be described later.

| | |
|---------------------------------|--------------------------------------|
| <i>Theridion zelotypum</i> | <i>Epeira marmorea</i> |
| " <i>spirale</i> | " <i>labyrinthea</i> (bog variety). |
| " <i>aurantium</i> | <i>Dictyna muraria</i> |
| <i>Steatoda borealis</i> | <i>Lycosa pratensis</i> |
| <i>Linyphia mandibulata</i> | <i>Pardosa groenlandica</i> |
| <i>Bathypantes concolor</i> | " <i>emertoni</i> (<i>pallida</i>) |
| <i>Lepthyphantes calcaratus</i> | " <i>diffusa</i> |
| <i>Helophora insignis</i> | <i>Castianeira pinnata</i> |
| <i>Gongylidium plumosus</i> | <i>Clubiona canadensis</i> |
| <i>Ceratinopsis nigriceps</i> | <i>Micaria montana</i> |
| <i>Erigone longipalpis</i> | <i>Misumena vatia</i> |
| <i>Pachygnatha brevis</i> | <i>Xysticus formosus</i> |
| <i>Zilla atrica</i> | <i>Dendryphantes militaris</i> |
| <i>Epeira trifolium</i> | " <i>flavipedes</i> |
| " <i>scolopetaria</i> | <i>Pellenes viridipes</i> |
| " <i>trivittata</i> | <i>Salticus scenicus</i> |

A CORRECTION

Page 67, line 28; page 68, line 5; for Vernon read Victoria; page 69, line 4, for *lipardis* read *liparidis*.

H. L. VIERECK.

